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Day of Obs. 1872.	Satellite.	Phenomena.	Oxford Mean Solar Time of Observation.			Greenwich Mean Solar Time from N. A.			Observer.
			h	m	s	h	m	s	
Apr. 11	III.	Ecl. reap. first seen	12	0	52·0	12	4	53·5	K.
	III.	,, usual brightness	12	3	5·6				
13	II.	Tr. ingr first contact	10	26	46·3	10	37		L.
	II.	,, last contact	10	34	15·1				
15	II.	Ecl. reap. first seen	10	55	40·9	11	1	5·9	K.
	II.	,, full brightness	10	56	43·2				
	I.	Tr. ingr. first contact	11	22	6·1	11	30		,,
	I.	,, bisection	11	24	35·7				
	I.	,, last contact	11	27	35·2				
16	I.	Occ. dis. first contact	8	30	0·2	8	40		L.
	I.	,, last contact	8	36	9·2				
17	IV.	Ecl. reap. first seen	10	14	18·6	10	22	32·6	,,
	IV.	,, fully seen	10	19	27·8				
	IV.	,, full brightness	10	22	27·3				
23	I.	Occ. dis. first contact	10	28	48·1	10	37		,,
	I.	,, bisection	10	31	47·6				
	I.	,, last contact	10	34	47·1				
May 1	I.	Tr. ingr. first contact	9	45	52·6	9	52		K.
	I.	,, bisection	9	48	37·1				
	I.	,, last contact	9	51	51·6				

Apr. 15. The same remark applies to the ingress of I. as on April 8.

The initials M., L., and K., are those of Mr. Main, Mr. Lucas, and Mr. Keating.

The observations were generally made either with the Heliometer or with the 10-foot telescope, or with both. The 42-inch Dollond was used on November 15 and 16 by K. and on December 20 by L., for the occultations of stars.

On Photographic Irradiation in over-exposed Plates. By Lord Lindsay and Mr. A. Cowper Ranyard.

The most cursory observer of any of the recent corona photographs must have remarked the apparent eating-in of the prominences over the limb of the dark Moon. A more careful examination of the photographs shows that the whole limb of the Moon is more or less eaten into, and that the indentations under the prominences are only exaggerations of a phenomenon which is present at all parts of the limb, but which varies in intensity according as the dark limb of the Moon is projected on a brighter or less luminous background.

In all over-exposed photographs of luminous objects upon a dark background, the brighter parts of the picture are found to be surrounded by a nebulous haze or border of light, which

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increases the diameter of the image formed by the luminous objects at the expense of those which are less luminous.

This nebulous haze has often been spoken of as "the extension of the chemical action," but without begging the question of its cause, we propose to speak of it as photographic irradiation. It has been found to vary with the time of exposure, and the relative brightness of the object and its background.

On examining the effects of photographic irradiation in a decidedly over-exposed picture, it will be seen that the nebulous fringes round luminous objects are distinctly divided into two parts—an inner and very marked border of light, following the contour of the luminous objects, and an outer and much less definite haze, thus:—

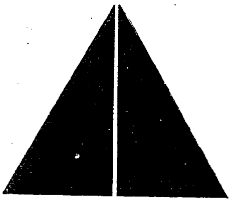

Fig. A.

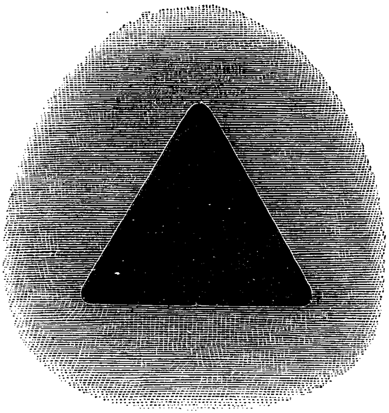

Fig. B.

where fig. A represents a normal photograph, and fig. B a decidedly over-exposed plate from the same object.

The inner border of light fades gradually from the inside outwards, and it is very difficult, and indeed impossible, to tell where the true image of the luminous object ends, and its photographic irradiation begins. While, on the other hand, the boundary between the outer and inner fringes (or halos) of irradiation is more definitely marked, although it would be difficult to say with any absolute precision, at what point the inner fringe terminates.

Our first experiments were devised in order to test whether reflections from the back surface of the plate played any part in the production of the fringes; for this purpose plates of ebonite and the so-called non-actinic yellow glass were prepared.

In the over-exposed photographs taken on ebonite, it was found that the outer haze had entirely disappeared; while in the photographs taken on plates of yellow glass the outer haze is still distinctly to be traced, though it is much fainter than on an ordinary white glass plate with the same exposure.

By placing a piece of wetted black paper at the back of an unground plate the outer haze may be greatly reduced, while it was found that by grinding both the back and the front surfaces

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of a yellow glass-plate, and covering the back with a coating of black varnish, the outer haze may be rendered quite imperceptible, while, however, the inner border of irradiation still remains as before.

From these experiments we may conclude that the outer haze is produced by reflections from the back of the plate; and the action of the wetted black paper in reducing the outer irradiation, may be explained by the consideration that the change of refractive index in passing from the glass to the film of water behind, is much less than in passing from glass into air. There is consequently less reflection at the back surface of the plate; most of the light immerges into the film of water, and is then absorbed by the black paper.

Fig. C represents a photograph taken upon a yellow glass plate, with a backing of wet black paper, but otherwise exposed under similar conditions to the photograph represented in fig. B.

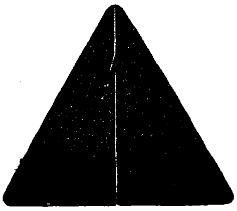

Fig. c.

The outer irradiation halo may therefore be entirely avoided for the future in any corona or other necessarily over-exposed photographs by the use of the opaque plates. If, however, it is considered important that the negatives should be capable of being copied by transmitted light, the outer halo may be still to a great extent avoided by the use of yellow glass plates with a backing of wet black paper or black varnish.

Secondly, as to the inner and more definitely-marked irradiation-edge which remained and seemed to be unaffected by the precautions that had served to rid us of the outer halo. Since the inner fringe was equally to be found on an opaque, and on a transparent plate, we felt ourselves justified in seeking for its cause in front of the first or upper surface of the prepared plate; that is, it must be referred either to some action taking place within the thickness of the collodion, or to the optical imperfections of the instrument.

In order to determine whether the scene of action lay within the thickness of the collodion, we placed an ivory ruler with a bevelled edge in immediate contact with the collodion film. The plate with the ruler upon it was then exposed within the camera, so that the image of an incandescent platinum wire fell partly upon the collodion film, and partly upon the ivory ruler. If the scene of action lay within the collodion film, we might expect the inner irradiation fringe to extend itself under the edge of the ruler, while if it were due to the optical imperfections of the lens, the image of the wire would be cut off sharply by the edge of the ruler.

On removing the plate from the camera, and before the ruler was shifted from its place on the collodion, the whole was exposed for a few seconds to the action of the light from a gas-burner, in order that the position occupied by the edge of the

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ruler might be faintly printed upon the collodion film. On developing the plate, it was found that the image of the wire was sharply cut off at the place occupied by the edge of the ruler, as in fig. D.

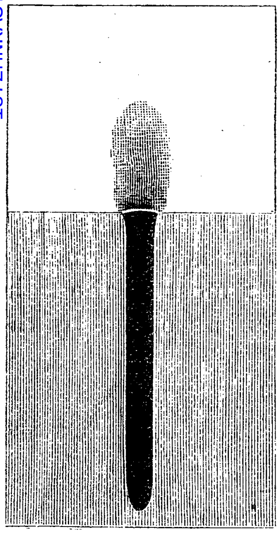
Fig. D.

The very faint action extending inwards under the ruler being evidently due to the want of perfect opacity in the ivory, it seems, therefore, to be clearly proved that the inner irradiation-edge is not caused by any chemical or other action taking place within the thickness of the collodion. But must be referred to the optical imperfections of the instrument which throws the image upon the collodion film.

It is instructive to remark that the photographic image of the wire is not cut off by an absolutely straight line at the edge of the ruler, but it is slightly convex, and is separated from the faint action which has apparently taken place through the ruler by a very narrow bright line, which appears to indicate the presence of a small capillary film of liquid along the edges of the ruler forming a minute cylindrical lens. At the point where the collodion was acted upon by the light, the minute cylindrical lens appears to have been interfered with, and depressed inwards towards the ruler, we may therefore conclude that the collodion film is slightly swelled or thickened by the action of the light upon it.*

The cause of the inner irradiation-edge seems to be that every point of a luminous object is not represented by a simple point of light in the luminous image; in other words, the circle of least diffusion of any pencil is a curve of sensible area, of which the central and most intense portions imprint themselves first upon the collodion.

Some further experiments were made in order to test whether the size of the circles of least diffusion was chiefly owing to chromatic aberration (in which case the difficulty might be got rid of by the use of reflectors); for this purpose a bath of solution of sulphate of copper was placed in front of a gas-burner, and the triangular diaphragm shown in fig. A was then placed

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* We are at present unable to find any explanation of the slight apparent thickening of the end of the image of the wire where it abuts upon the ruler, but the same thickening is to be found in all the plates. It may be well to remark that it appears evident from slight indication in the negatives which it would be difficult to render in a woodcut, that the true edge of the ruler coincides with the inner side of the white line (or with the side away from the image of the wire). The convexity of the end of the image of the wire cannot, therefore, be regarded as indicating even a slight chemical encroachment. The slightly tapered appearance of the other end of the image of the wire is due to the fact that the platinum incandescent wire is cooled at its points of contact with the thick copper wires of the circuit.

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between the sulphate of copper bath and the lens of the camera, but the blue screen thus formed seemed to have very little effect in altering the breadth of the irradiation-fringe, only slightly retarding the rate of its formation; a similar result was obtained on placing a piece of yellow glass in front of the diaphragm; in this case, however, the formation of the fringe was still further retarded.

Photographers have long known that by making use of stops they can obtain a much sharper image. By way of experiment, we cut off the edges of the lens with a circular stop, and found that the inner irradiation fringe was thus greatly decreased. It seems, therefore, fair to argue that the aberration of oblique pencils exceeds in magnitude the other disturbing causes, and that it will be well, in making preparations for the photographic observation of the Transit of *Venus*, to avoid as much as possible all oblique pencils.

We would, therefore, place our photographic plates in the primary focus, and thus avoid the necessarily deep curves of any arrangement of lenses which may be used for enlarging the image. Whether it would be best to make use of a reflector or a refractor, remains to be settled by further experiment, but our present experiences would lead us to vote in favour of the reflector.

We cannot conclude without returning our best thanks to Mr. H. Davis, who has rendered us the most willing assistance in carrying out all of the foregoing experiments.

The Aurora of February 4th, 1872. By the Rev. J. Slatter.

A desire having been expressed by Mr. Finlayson in the April Number of the *Monthly Notices* for any observation of this aurora, I forward to you the entry I made of it.

Feb. 4, 7^h 20^m. A fine aurora with much rosy light, but hidden by low fleecy clouds, with a slight drizzling rain. At the time indicated, there was a break in the clouds which showed the dome-formation, and suggested a corona either formed and passed, or about to form, exactly over *Aldebaran*, by about 5°, which was then in azimuth almost on the magnetic meridian.

My place of observation is in N. lat. 51° 30′ 15″; long. W. 1° 1′ 15″.

On Oct. 24, 1870, I obtained a simultaneous observation of the corona with Greenwich, viz. at 8^h 20^m, G.M.T. At this station it exactly covered γ *Pegasi*; at Greenwich it covered a spot midway between β and η *Pegasi*, which may be assumed to have been R.A. 22^h 47^m 13^s, N.P.D. 61° 32′.

From these data it would appear that the height of the corona was nearly 118 miles in the zenith of a spot in the Channel about thirty miles north of Havre. But this depends entirely on the assumption that it was the same phenomenon (*i.e.* identical and not only apparent) which was observed at both places. The